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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/912,737	07/26/2001	Luona Goh	CS01-001	5502

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EXAMINER

BROPHY, JAMIE LYNN

ART UNIT	PAPER NUMBER
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2822

DATE MAILED: 08/11/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Applicati n N .

09/912,737

Applicant(s)

GOH ET AL.

Examin r

J. L. Brophy

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-6,12,14-17 and 23-32 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

- 5) ☐ Claim(s) _____ is/are allowed.

- 6) ☒ Claim(s) 1,3-6,12,14-17 and 23-32 is/are rejected.

- 7) ☐ Claim(s) _____ is/are objected to.

- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 July 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

This office action is in response to the RCE and amendment filed 7/9/03.

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 7/9/03 has been entered.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or
(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

Claims 1, 3 and 6 are rejected under 35 U.S.C. 102(b) as being anticipated by

Publication No. JP08102489A.

Publication No. JP08102489A teaches a method that comprises depositing a low dielectric constant material layer 8 on a substrate 1, wherein said low dielectric constant material 8 is a plasma TEOS film that has a thickness between about 1000 and 2000 angstroms;

Implanting silicon ions 9 into said low dielectric constant material layer 8; and

Thereafter depositing a TEOS-based silicon oxide layer 11 overlying said low dielectric constant material 8, wherein the TEOS-based silicon oxide layer 11 has a thickness of 4000 to 6000 angstroms.

See Fig. 1 and English Abstract.

Claim 1 is rejected under 35 U.S.C. 102(b) as being anticipated by Muroyama (JP405129280A).

Muroyama teaches a method that comprises depositing a low dielectric constant material layer 3 on a substrate 1, wherein said low dielectric constant material 3 is a thermal oxide;

Implanting silicon ions into said low dielectric constant material layer 3; and

Thereafter depositing a TEOS-based silicon oxide layer 4 overlying said low dielectric constant material 3.

Muroyama also teaches an embodiment wherein the low dielectric constant material is PSG (see Fig. 2).

See Fig. 1 and English Abstract.

Claims 1, 3 and 6 are rejected under 35 U.S.C. 102(e) as being anticipated by Watanabe et al (6,214,749).

Watanabe et al teach a method that comprises depositing a low dielectric constant material layer 6 on a substrate 1, wherein said low dielectric constant material 6 is organic SOG that has a thickness of about 4000 angstroms;

Implanting silicon ions into said low dielectric constant material layer 6 (col. 9, line 25); and

Thereafter depositing a TEOS-based silicon oxide layer 8 overlying said low dielectric constant material 6, wherein the TEOS-based silicon oxide layer 8 has a thickness of 2000 angstroms.

See, for example, Figs. 2C and 3A and accompanying text.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 4, 5 and 24-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Publication No. JP08102489A or Watanabe et al.

Publication No. JP08102489A teaches a method that comprises implanting silicon ions into a dielectric layer as applied to claims 1, 3 and 6 above. In addition,

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Publication No. JP08102489A teaches that the silicon ions are implanted at a dosage of about 1×10^{11} and 1×10^{12} ions/cm².

Watanabe et al teach a method that comprises implanting silicon ions into a dielectric layer as applied to claims 1, 3 and 6 above.

However, Publication No. JP08102489A does not specifically teach the implant energy or the implant depth. Watanabe et al do not specifically teach the implant energy, dosage or depth.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to optimize and select an appropriate implant energy, dosage and depth for the silicon ions. The selection of parameters such as energy, power, concentration, temperature, time, depth, thickness, etc., would have been obvious and involve routine optimization which has been held to be within the level of ordinary skill in the art. "Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from results of prior art...such ranges are termed 'critical ranges' and the applicant has the burden of proving such criticality...More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *In Re Aller* 105 USPQ 233, 235 (CCPA 1955). See also MPEP 2144.05.

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Claims 3-6 and 24-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Muroyama.

Muroyama teaches a method that comprises implanting silicon ions into a dielectric layer as applied to claim 1 above.

However, Muroyama does not specifically teach the thickness of the low dielectric constant layer or the TEOS-based dielectric layer. Muroyama does not specifically teach the implant energy, dosage or depth.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to optimize and select an appropriate thickness for the dielectric layers, and an appropriate implant energy, implant depth and implant dosage for the silicon ions. The selection of parameters such as energy, power, concentration, temperature, time, depth, thickness, etc., would have been obvious and involve routine optimization which has been held to be within the level of ordinary skill in the art.

“Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from results of prior art...such ranges are termed ‘critical ranges’ and the applicant has the burden of proving such criticality...More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation”. *In Re Aller* 105 USPQ 233, 235 (CCPA 1955). See also MPEP 2144.05.

Claims 12, 14-17, 23 and 28-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Watanabe et al.

Watanabe et al teach a method that comprises depositing a low dielectric constant material layer 6 on a substrate 1, wherein said low dielectric constant material 6 is organic SOG that has a thickness of about 4000 angstroms;

Implanting silicon ions into said low dielectric constant material layer 6 (col. 9, line 25);

Thereafter depositing a TEOS-based silicon oxide layer 8 overlying said low dielectric constant material 6, wherein the TEOS-based silicon oxide layer 8 has a thickness of 2000 angstroms;

Forming an opening 9 through the TEOS-based silicon oxide layer 8 and the low dielectric constant material layer 6; and

Forming a copper layer 10 (see col. 19, lines 36-41) within the opening 9.

See, for example, Figs. 2C to 3C and accompanying text.

However, Watanabe et al do not teach the additional steps of forming a second low dielectric constant material layer and a second TEOS-based silicon oxide layer. In addition, Watanabe et al do not specifically teach the step of forming a barrier layer in the opening. Watanabe et al do not specifically teach the implant energy, dosage or depth.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to repeat the steps of forming a low dielectric constant material

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layer and forming a TEOS-based silicon oxide layer because it is well established that the mere repetition or duplication of a prior art process or means to accomplish an expected additive function or result is prima facie obvious absent a disclosure that the process is for a particular unobvious purpose, produces an unexpected result, or is otherwise critical. See, for example, *In re Ockert*, 114 USPQ 330 (CCPA 1957); *In re Schuelke*, 96 USPQ 421 (CCPA 1953); *In re Hertrich*, 73 USPQ 442 (CCPA 1947); *Long Mfg. N.C., Inc. v. Condec Corp.*, 223 USPQ 1213 (DC ENC 1984); *St. Regis Paper Company v. Bemis Company, Inc.*, 193 USPQ 8 (CA 7 1977); *Hofschneider Corp. v. Lane et al., doing business as Lane and Co.*, 71 USPQ 126 (DC WNY 1946).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to modify the method taught by Watanabe et al by forming a barrier layer in the opening because it was known in the art that, in order to eliminate copper diffusion, a barrier layer must be used when forming copper interconnects.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to optimize and select an appropriate implant energy, dosage and depth for the silicon ions. The selection of parameters such as energy, power, concentration, temperature, time, depth, thickness, etc., would have been obvious and involve routine optimization which has been held to be within the level of ordinary skill in the art. "Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in

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kind and not merely degree from results of prior art...such ranges are termed 'critical ranges' and the applicant has the burden of proving such criticality...More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *In Re Aller* 105 USPQ 233, 235 (CCPA 1955). See also MPEP 2144.05.

Response to Arguments

Applicant's arguments filed 7/9/03 have been fully considered but they are not persuasive.

Applicant mainly argues that the term "low dielectric constant" means a dielectric constant of less than 3 (see, for example, p. 4, lines 6-10 of arguments filed 7/9/03). However, such a definition is not found in the specification and is not supported by the specification. In fact, attributing the "less than 3" definition to the claim limitation "low dielectric constant" is in conflict with the specification. As examples of the "low dielectric constant material", the specification mentions alkyl silsesquioxane, FSG and PSG (see specification, bottom of p. 6 to top of p. 7). The dielectric constant of FSG, for example, is above 3 (see, for example, US Patent 6,558,747 to Nakata et al, col. 1, lines 33-34; US Patent 6,583,071 to Weidman et al, col. 2, lines 7-9; and US Patent 6,589,610 to Li et al, col. 3, lines 19-21). In addition, Muroyama teaches an embodiment wherein the low dielectric constant material is PSG (see 35 USC § 102 rejection of claim 1 in view of Muroyama above). The preferred materials for the low dielectric constant material are porous or non-porous carbon-based silicon oxides, porous or non-porous doped silicon

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oxides, porous or non-porous organic polymers and porous or non-porous inorganic polymers. Many materials that fall into those categories have a dielectric constant greater than 3. Therefore, applicant's arguments are not found persuasive since construing the claims so narrowly is inconsistent with the specification.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to J. L. Brophy whose telephone number is (703) 308-6182. The examiner can normally be reached on M-F (8:00-5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Q.L.B.

jlb

July 30, 2003


AMIR ZARABIAN
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